

SOUTHWEST FISHERIES CENTER

NATIONAL MARINE FISHERIES SERVICE

SOUTHWEST FISHERIES CENTER
LIBRARY

P.O. BOX 271

LA JOLLA, CA 92038

MARCH 1986

MAY 2 1986

National Marine Fisheries Service
2570 Dole Street
Honolulu, Hawaii

THE FOOD HABITS OF THE CALIFORNIA SEA LION, *Zalophus californianus*, AT SAN CLEMENTE ISLAND, CALIFORNIA, SEPTEMBER 1981 THROUGH MARCH 1983

by

Mark S. Lowry and C. W. Oliver

ADMINISTRATIVE REPORT LJ-86-07

This Administrative Report is issued as an informal document to ensure prompt dissemination of preliminary results, interim reports and special studies. We recommend that it not be abstracted or cited.

The food habits of the California sea lion,
Zalophus californianus, at San Clemente Island, California,
September 1981 through March 1983

Mark S. Lowry and C. W. Oliver
Southwest Fisheries Center
National Marine Fisheries Service
P.O. Box 271
La Jolla, California 92038

March 1986

Administrative Report LJ-86-07

CONTENTS

	Page
INTRODUCTION.....	1
METHODS.....	2
RESULTS.....	5
DISCUSSION.....	7
ACKNOWLEDGEMENTS.....	11
LITERATURE CITED.....	12

LIST OF TABLES

Table		Page
1	List of known <u>Zalophus californianus</u> prey compiled from the literature and from the present study.....	15
2	Collection periods, dates of collection, and numbers and type of <u>Zalophus californianus</u> scat samples obtained from San Clemente Island, California from September 1981 through March 1983.....	21
3	Occurrence of prey, composition of prey, and minimum number of prey determined for positive-identified prey found in 424 California sea lion (<u>Zalophus californianus</u>) scats collected at San Clemente Island, California, from September 1981 through March 1983.....	22
4	Occurrence of prey, composition of prey, and minimum number of prey determined for all questionable prey identifications and unidentified prey found in 424 California sea lion (<u>Zalophus californianus</u>) scats collected at San Clemente Island, California from September 1981 through March 1983.....	23
5	Percent occurrence and percent minimum number of prey for seven dominant prey found in California sea lion (<u>Zalophus californianus</u>) scats collected at San Clemente Island, California for 16 collection periods during September 1981 through March 1983.....	24

LIST OF FIGURES

Figure		Page
1	San Clemente Island (SCI) showing area where census and food habits were conducted on California sea lions, <u>Zalophus californianus</u> , during September 1981 through March 1983.....	25
2	Percent occurrence and percent minimum number of the seven dominant prey found in California sea lion (<u>Zalophus californianus</u>) scats collected at San Clemente Island, California, from September 1981 through March 1983.....	26

The food habits of the California sea lion,
Zalophus californianus, at San Clemente Island, California,
September 1981 through March 1983

Mark S. Lowry and C. W. Oliver
National Marine Fisheries Service

ABSTRACT

We studied the food habits of the California sea lion, Zalophus californianus, at San Clemente Island, California by collecting 498 scats from September 1981 through March 1983. We examined fish otoliths, cephalopod beaks, and other prey remains to identify prey to the lowest taxonomic level possible and positively identified 21 prey to species, 6 prey to genus, and 6 prey to family. We identified seven prey as common in the diet of the sea lions at San Clemente Island (jack mackerel, Trachurus symmetricus; northern anchovy, Engraulis mordax; market squid, Loligo opalescens; rockfish, Sebastes spp.; Pacific whiting, Merluccius productus; Pacific mackerel, Scomber japonicus; and blacksmith, Chromis punctipinnis). We found the first three most often in the sampled scats and all seven showed extreme temporal variability.

INTRODUCTION

The food habits of the California sea lion (Zalophus californianus) have been of interest since the beginning of the 1900's when Rutter et al. (1902) and Dyche (1903) made their studies. An assortment of sea lion prey items has been identified since then (Table 1) using a variety of methods: (1) direct observations of feeding animals (Bonnot, 1932; and, Jameson and Kenyon, 1977); (2) observations made during fishing operations (Briggs and Davis, 1972); (3) gastrointestinal content analysis of dead beach-cast animals or animals which were intentionally taken for scientific purposes (Dyche, 1902; Rutter et al. 1902; Bonnot, 1928; Scheffer and Neff, 1948; Fiscus and Baines, 1966; Morejohn et al. 1978; and Jones, 1981); and (4) analyses of spewings or scats (Ainley et al., 1977, 1978, 1982; Antonelis and Fiscus, 1980; Antonelis et al. 1984; Auriolles et al., 1984; and Morejohn et al. 1978).

The current California sea lion population of the western United States breeds primarily on the offshore islands of San Miguel, San Nicolas, San Clemente, and Santa Barbara located in the Southern California Bight (Seagars et al., 1985). Year-

round haulouts include other offshore islands as well as many coastal breakwaters, jetties and harbor bouys. Our counts of sea lions at San Clemente Island (SCI) indicate a peak population of 1500-2000 animals. Most of the animals are found along the western shoreline, which extends from about two kilometers south of Mail Point to about half of a kilometer north of Seal Cove Point (Figure 1). Smaller numbers of animals (fewer than 200) are frequently found at the Northwest Harbor islet. Pups are found mostly near Mail Point throughout the year, with the greatest number occurring during July-September.

We analyzed sea lion scats from San Clemente Island to identify prey composition and temporal differences in the diet of sea lions in this southernmost island of the Southern California Bight. Our food-habits study concentrated on the sea lions at Mail Point to about 1-1/2 kilometers south of that point (Figure 1), with the majority of samples obtained south of Mail Point. While this area to the south is occupied by all age classes throughout the year, it is not an area of concentrated breeding.

METHODS

We planned our collection of scat samples in a manner that resulted in minimal disturbance to the animals in order to disrupt as little as possible concurrent investigations on the numbers and distribution of all pinnipeds at SCI. We developed a scheme in which areas were cleared at the start of our study and then monitored by collecting or clearing all scats found during each visit. We made no effort to describe age classes or sexes of animals at the various monitored sites, although all ages and sexes occurred in these areas. The areas chosen for scat collections were often vacated during the day when the animals moved to the water's edge. When the monitored areas were populated by sea lions, we collected or cleared the scats from these areas on subsequent visits. This collection scheme provided fresh and dry scat samples for temporal analysis of the sea lion's diet during the study period while assuring that the animals were not repeatedly disturbed.

We made sixteen scat collections from September 1981 through March 1983 (Table 2). These collections were made from 2 weeks to up to 2-1/2 months apart at the monitored collection areas. Scats were collected individually and placed in a Whirl-pak¹ plastic bag. Individual scats from the same area were packaged in a larger plastic bag and a label was attached which designated the area of collection and date. Samples were stored in large air-tight plastic containers and kept frozen until processed.

¹Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

During laboratory processing, we gave each scat a coded number before it was soaked in a Zip-lock¹ or Whirl-pak¹ plastic bag containing water and a small amount of mild liquid dish soap. After soaking for an average of one week, rocks and most of the water were removed from the bag and a volume was taken of the remaining contents. This provided a rough approximation of volume for each scat. All scats were then individually sorted by rinsing through a set of three nested sieves (2.8 mm, 1.4 mm, and 1.0 mm mesh size). We collected all fish otoliths and cephalopod beaks for identifying prey. Otoliths were first placed in ethyl alcohol for a few minutes before they were dried. After identification, the otoliths were placed, by species, in gelatin capsules for storage. All cephalopod beaks and other soft parts recovered were stored in vials containing 70% ethyl alcohol. Fragments of pelagic red crabs (Pleuroncodes planipes) were recorded whenever present and either stored in 70% ethyl alcohol or discarded. We discarded the remaining scat material, composed of fish bones, fish scales, and clay-like material. We identified prey to the lowest taxonomic level possible using fish otoliths, cephalopod beaks, or other prey remains.

Although fish have three pairs of otoliths (sagitta, asteriscus and lapillus), we used the sagittal otolith (the largest) in making identifications because it was most commonly found in the samples. The two other otoliths (asteriscus and lapillus) were occasionally found but were not used for identification purposes. We based our identifications on the following material: (1) published photographs and drawings (Fitch, 1966, 1967, 1968, 1969, 1972, 1979; Fitch and Barker, 1972; Fitch and Brownell, 1968; Fitch and Craig, 1964; Frost, 1981; and Morrow, 1979); or (2) otoliths removed from identified fish (SWFC otolith collection and the John Fitch otolith collection at the Los Angeles County Museum of Natural History); or (3) otoliths obtained from California sea lion scats, and subsequently identified by John Fitch.

We grouped otolith identifications into one of three categories: (1) positive, (2) questionable, or (3) unidentified. Positive identifications were obtained from otoliths which had enough diagnostic characters to render an accurate identification. Questionable identifications resulted from otoliths which, due to digestion or breakage, did not possess enough diagnostic characters to make a positive identification, but enough characters remained to associate the otolith to either family, genus, or species. Unidentified otoliths were those that were too digested to identify (i.e. no distinguishing characters

¹Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

present) or not recognized even though there were distinguishing characters present. Unidentifiable otolith fragments were coded separately.

We separated the sagittal otoliths into categories of left or right for each prey before counting them. Only the presence or absence was noted for otolith fragments or otoliths for which left or right could not be determined. All otolith identifications were performed twice before being entered into a computer database.

We used the paired chitinous beak of cephalopods to identify squid and octopus. Each pair was separated into an upper and lower mandible by their distinct shape, and either mandible was used for identification. We compared recovered beaks to a pictorial guide (Iverson and Pinkas, 1971) or the collection of cephalopod beaks at the Santa Barbara County Museum of Natural History, Santa Barbara, California. We divided identifications of cephalopod beaks into the same three categories that were used for otoliths: positive, questionable, and unidentified. We then counted the number of upper and lower mandibles for each species. Pieces of beaks were allocated to an unidentified cephalopod parts category. All cephalopod beak identifications were performed twice before being entered into a computer database.

We identified pelagic red crabs, Pleuroncodes planipes, by comparing pink-to-red crustacean exoskeletal fragments with complete specimens. Chilipeds and other exoskeleton material with setae were found in the scats. Numbers of individual crabs represented in a scat could not be determined; therefore, only presence or absence in a scat were noted.

We used three computations as indices of prey found in the scats. The first, percent occurrence (PO), is defined as:

$$PO_x = O_x / N_s \times 100$$

where PO_x = percent occurrence of prey x; O_x = the number of scats (i.e. occurrences) in which prey x was found; and N_s = the number of scats from the set of samples examined which contain identifiable otoliths, beaks, or other prey remains. Because the summation of PO's for all prey found in a sampled period almost never equal one hundred percent (due to the presence of more than one prey in a single scat), we calculated a second index to standardize these occurrences for each prey from the entire scat sample:

$$PPC_x = O_x / O_a \times 100$$

where PPC_x = percent prey composition of prey x; and O_a = the sum of occurrences of all prey found.

The third computation describes the percent minimum number (PMN) of prey for all scats collected in the sample period:

$$PMN_x = N_x / N_a \times 100$$

where PMN_x = percent minimum number of prey x ; N_x = the maximum count of the right and left otoliths for fish, or the upper and lower beaks for cephalopods of prey x ; and N_a = the sum of the maximum count of otoliths and beaks of all prey. N_x uses the maximum count because in many instances these hard parts were not found in equal numbers for each scat sample. Interpretation of this formula is limited because it excludes (1) all prey hard parts found which were broken or digested and thus could not be categorized as either left or right otoliths or, upper or lower beak mandible and (2) prey which lacked otoliths or beaks (e.g. pelagic red crab) could not be included. However, we feel that this index is useful because it reflects the number of individual prey for most of the prey represented in the scat samples.

RESULTS

We did not find any prey represented by the prey remains that we used for making our identifications in 74 scats (14.9%) from the total sample of 498 scats that we collected. In the remaining 424 scats we were able to determine that 40.8% had one prey per scat, 26.2% had two prey per scat, 19.1% had three prey per scat, 7.1% had four prey per scat, and 6.6% had five or more prey per scat.

Of the 498 scats collected from September 1981 through March 1983, we used the 424 scat samples that had prey identified from them to determine the representation of all SCI sea lion prey found during this study (Tables 3 and 4). Positive identifications were made to the species level for 21 species, to genus level for 6 genera, and to family level for 6 families (Table 3).

Positively identified prey, identified to the lowest taxonomic level possible, constituted 85.5% composition of all prey occurrences. Questionable prey identifications made up 9.6%, and unidentifiable prey accounted for 4.9% of the composition of prey occurrences. Otoliths and beaks were found in 83% and 29% of the scats, respectively. Unidentifiable otolith fragments were found in 23% of the scats, and unidentified secondary otoliths were found in 19% of the scats. By noting the presence of fish bones and cephalopod beaks in the scats we were able to determine that fish occurred in 98% of the scats and cephalopods in 29% of the scats.

We found seven prey in at least 10% of the 424 scat samples. (Table 3): jack mackerel, (Trachurus symmetricus); northern anchovy, (Engraulis mordax); market squid, (Loligo opalescens); rockfish, (Sebastes spp.); Pacific whiting (hake), (Merluccius productus); Pacific mackerel, (Scomber japonicus); and blacksmith, (Chromis punctipinnis). These seven prey (all

positive identifications, Table 3) represented a combined PPC of 77% and PMN of 96% and we found them in most of the sampling periods during the study (Figure 2, Table 5). The relative representation of these seven prey in the SCI sea lions diet is increased if the questionable identifications for these prey (Table 4) are included with the values for the positive identifications (Table 3). Questionable identifications of these prey made up 9% PPC and 2% PMN. Combining the results of the positive and questionable identifications of these seven prey yields a PPC of 86% and a PMN of 98%.

We consider three of the seven common prey (jack mackerel, northern anchovy, and market squid) to be major prey of the sea lions at SCI because each had a PO, PPC, and PMN index value greater than 10%:

prey name	PO	PPC	PMN
jack mackerel	46%	21%	19%
northern anchovy	39%	18%	39%
market squid	25%	11%	22%
rockfish	17%	*	*
Pacific whiting	17%	*	*
Pacific mackerel	15%	*	*
blacksmith	10%	*	*

* = <10%

We did not find any prey represented by the prey remains that we used for making our identifications in 60 scats (14.0%) from the sub-sample of 428 scats suitable for temporal variability analysis. The total scat sample for the temporal comparison was 368 scats with a range of 5 to 51 scats for each sampled collection period. We observed the following for the seven common prey from these data (Figure 2, Table 5):

1. Jack mackerel (Trachurus symmetricus) showed high index values (i.e. PO >40%) in the diet during September through November 1981; and May through June, and August through December 1982. It was also found in the diet during other times of the year, but at lower index values.
2. Northern anchovy (Engraulis mordax) showed high index values (i.e. PO >40%) in the diet during March through May 1982; mid-July 1982; October 1982; and February through March 1983. Index values dropped to extremely low values in the diet between the peak periods.
3. Market squid (Loligo opalescens) showed high index values (PO >30%) in the diet in September and October 1981; May through June 1982; end of July 1982; and December 1982. It was found in the diet during other times of the year, but at lower index levels.

4. Pacific whiting (Merluccius productus) showed higher index values (i.e. $PO > 25\%$) in the diet during October 1981; April through May 1982; and late July 1982. It occurred at lower levels in the diet at other times of the year.
5. Rockfish (Sebastes spp.) showed higher index values (i.e. $PO > 25\%$) in the diet in May 1982; August 1982; and from December 1982 through March 1983. It occurred at lower levels in the diet at other times of the year.
6. Pacific mackerel (Scomber japonicus) showed high index values (i.e. $PO > 20\%$) in September and October 1981; April through June 1982; and August through December 1982. It occurred at lower levels in the diet at other times of the year.
7. Blacksmith (Chromis punctipinnis) was present in the diet in October through November 1981 ($PO \geq 19\%$); April through June 1982 ($PO \geq 8\%$); showed a steady, though slow, decline August 1982 through February 1983 ($PO = 11\%$ to 6%) and then rose sharply in March 1983 ($PO = 17\%$).

Fragments of the pelagic red crab, Pleuroncodes planipes began appearing in the scat samples during February and March of 1983 with a PO of 23% and 21%, respectively. No other prey, except for the seven dominant prey already mentioned, were observed by us to occur in the samples at such a high percentage during any other sampling period.

DISCUSSION

In our study at SCI we analysed 498 California sea lion scats (140 fresh and 358 dry). Although spewings were collected, the sample is small relative to the number of scats collected (14 spewings vs 498 scats), and were not included in our analysis. The total number of scats collected per sampled period ranged from 3 to 68 (Table 2).

We attempted to assess temporal changes in the diet of the SCI sea lions by analysis of scats representing one interval between collection periods (Table 2), with two exceptions. Since only a few scat samples were collected on January 28, 1982 (representing the period from November 15, 1981 to March 24, 1982), these were not used in our temporal diet analysis. Data for collection periods 7 and 8 were combined in the temporal analysis to obtain a larger representative sample for that month. The dry scats that represented more than one interval between collections ($N=49$) were not used in the analysis of temporal variability, but were used to determine the overall representation of prey for SCI sea lions.

We identified several items not previously noted as prey of sea lions.

FISHES:

Blacksmith (Chromis punctipinnis)
 Senorita (Oxyjulis californica)
 Stripefin poacher (Xeneretmus riteri)
 Topsmelt (Atherinops affinis)
 Blacktail snailfish (Careproctus melanurus)
 Bigfin eelpout (Lycodes cortezius)
 Pelagic red crab (Pleuroncodes planipes)

SQUIDS:

Abraliopsis sp.
Mastigoteuthis sp.
Octopodoteuthis deletron

Our results also show that the sea lions at SCI appear to feed primarily on fish, and to a lesser degree on cephalopods as indicated by the presence of fish bones in 98% of the scats and cephalopod beaks in 29% of the scats.

Our results indicate that the diet of the sea lions at SCI varies through time (Figure 3 and Table 5). The relative proportions of prey represented in the samples fluctuated and the apparent major prey changed within a short period. Two patterns were observed from the data which characterize the presence of major prey in the scats of sea lions from SCI: (1) One prey will dominate all others and will appear in almost every scat from that sampling period; or (2) several prey will be represented in the scats from the same sampling period, but the proportions of each prey will differ between collections (e.g. prey x will be in more scats than prey y during collection #1, but prey y will be in more scats than prey x in collection #2).

The relationship between consumption, availability, and abundance of sea lion prey is reflected by the relative occurrence of each prey in the scat sample (PO), relative occurrences between prey (PPC), and by the minimum number of prey (PMN). Percent occurrence (PO) reflects prey consumption without regard to other prey, and may indicate temporal availability, selectivity, or ease of capture of individual prey. Percent composition of prey (PPC) reflects the proportions between prey consumed. Percent minimum number (PMN) of prey reflects numbers of prey and indicates minimum consumption of individual prey.

The results we obtained at SCI indicate differences in both prey composition and temporal variability from those described by Bailey and Ainley (1982) for sea lions at the Farallon Islands off central California. Where our results (Table 3) show seven common prey (jack mackerel, northern anchovy, market squid, Pacific whiting, Pacific mackerel, rockfish, and blacksmith),

theirs show only two (Pacific whiting and rockfish). They found Pacific whiting during the spring and summer, and juvenile rockfish during the fall and winter. At SCI we found that the presence of the seven common prey in the diet of sea lions fluctuated throughout the year (Figure 3, Table 5). These differences between the two islands may be due to differences in the sampling periods (1981-1983 for our study; 1974-1978 for the Farallon Island study) or to differences in prey availability in each area.

Sea lion populations which are relatively near to each other would be expected to show more homogeneity in their diet, thus indicating similar availability or abundance of the prey within areas of close proximity. Data available from the spring and summer food-habits study of the San Miguel Island sea lions in 1978-79 by Antonelis et al. (1984) were compared with our results. Although time periods differ for each study, the results identified four major prey (Pacific whiting, rockfish, northern anchovy, and market squid) at San Miguel Island and three (northern anchovy, jack mackerel, and market squid) in our study at SCI. Thus, two (northern anchovy and market squid) of the three major prey at SCI were included as major prey at San Miguel Island, and, while two of the four major prey (rockfish and Pacific whiting) at San Miguel Island were not major at SCI, they were among the common prey at SCI. Jack mackerel, a major prey for the sea lions at SCI, was a minor prey item at San Miguel Island. Blacksmith were not found in the diet of the sea lions from San Miguel Island, but occurred frequently in the SCI study. Because the distribution and availability of these prey could differ between years, studies in each area should be made concurrently to define similarities or differences of diets.

Extreme temporal fluctuations in the representation of prey found in the diet of the sea lions from SCI may reflect changes in availability or abundance of these prey near SCI. During mid-July of 1982, northern anchovy showed a dramatic increase in percent occurrence (94%) from almost no occurrence (7%) two weeks earlier, then dropped to 33% two weeks later and to 5% by August 21, 1982. This sudden shift in the diet to northern anchovy, in the midst of high jack mackerel occurrences before and after this period was perhaps due to high availability or abundance of northern anchovies during this short time period.

We do not know whether the consumption of red crabs by sea lions at SCI in February and March of 1983 indicates diminished supplies of the sea lions' usual prey or further evidence of their apparent non-selectivity in prey. Warm tropical water moved into the Southern California Bight sometime in late 1982 due to an El Niño oceanographic phenomena and this warm water carried the red crabs into the area from southern Baja California. The effects of this El Niño event on the sea lion population and its food supply are not known.

The relative proportions of prey consumed may in fact reflect prey importance to the animals' health. Analyses of

other factors such as the relative size and caloric value of a prey, and the relative amount of effort an animal expends in obtaining various prey need to be considered. Also, since sea lions generally must feed constantly (i.e. they do not haulout for long periods of time), prey which are generally available may be of more importance than those which appear seasonally. Although seasonally abundant prey may appear to be consumed in greater amounts, both in percent occurrence and minimum numbers, when the data are viewed over a longer period their relative importance to the animals may be less. An analysis of the percent prey-species consumed, by all combinations of prey may provide insight into prey, or combinations of them, which may be of importance to the animals.

Six of the common prey identified during the SCI sea lion food-habits study (jack mackerel, northern anchovy, market squid, Pacific mackerel, Pacific whiting, and rockfish) are of commercial and sport value. Although both fishermen and sea lions prey on these, there is no current evidence to indicate that if one group did not take these prey (i.e. sea lions), the other group (i.e. fishermen) would increase its take.

The food requirement of the U.S. population of sea lions could have a significant impact on forage preferences and be in direct competition with man for commercial and sport fisheries resources. With a U.S. population of sea lions currently estimated at 69,700 (DeMaster, 1983) and increasing at a growth rate of approximately 5% per year (DeMaster, et. al., 1982), total consumption has been estimated at roughly 115,000 to 295,000 mt. of biomass per year (DeMaster, 1983). This growth in the sea lion population, and its estimated consumption, raises questions such as (1) will there be greater competition between sea lions and fishermen for finfish and squid as a result of increased numbers of sea lions? and (2) what is the effect of the population growth of the sea lion on the ecosystem?

ACKNOWLEDGEMENTS

We thank Jan Larsen of Staff Civil Engineers, Department of the Navy at North Island, California for all of the logistical help involved in getting the study going at SCI. Also, we thank the transportation branch at SCI for furnishing vehicles to get to the study site at Mail Point. Many thanks of appreciation of a job well done go to Roberta Folk, NOAA Junior Fellow, who helped in rough sorting many of the scats and coding the information for computer keypunching. Her great help in this project was instrumental, and for that we are very grateful. Thanks also to Lisa Ferm and Doug DeMaster who helped collect scats and to Brent Stewart of Hubbs Sea World Research Institute for his advice on collecting and sorting scats when the project began. Eric Hochberg of the Santa Barbara Museum of Natural History assisted with the cephalopod beak identifications and his help is very much appreciated. Bill Walker is also recognized for his help in the early stages of otolith and cephalopod beak identifications and as is Mark Roeder in the later stages of otolith identifications for allowing us the use of his otolith reference collection. We are also grateful to the Los Angeles County Museum of Natural History for allowing us to use the John Fitch otolith reference collection. We thank Jay Walker, Eugene Sibald and Lily Tang for their computer programming help. Special recognition is given to Roy Allen who provided illustrative services and Cliff Ratcliffe who typed the manuscript. Many useful comments which improved the manuscript were given by Gary Sakagawa, Wesley Parks, Doug DeMaster, Jean Michalski and Brent Stewart.

LITERATURE CITED

- Ainley, D.G., H.R. Huber, and K.M. Bailey. 1982. Population fluctuations of California sea lions and the Pacific whiting fishery off central California. *Fish. Bull.*, 80(2):253-258.
- Ainley, D.G., H.R. Huber, R.P. Henderson, T.J. Lewis, and S.H. Morrell. 1977. Studies of Marine Mammals at the Farallon Islands, California, 1975-1976. Final Rep. MMC Contract MM5AC020. NTIS pub. PB-226249. 32pp.
- Ainley, D.G., H.R. Huber, S.H. Morrell, and R.R. LeValley. 1978. Studies of marine mammals at the Farallon Islands, California, 1976-1977. Final Rep. MMC Contract MM6AC027. NTIS pub. PB-286-603. 19pp.
- Antonelis, G.A. and C.H. Fiscus. 1980. The pinnipeds of the California current. *Calif. Coop. Oceanic Fish. Invest. Rep.*, 21:68-78.
- Antonelis, G.A., C.H. Fiscus, and R.L. DeLong. 1984. Spring and summer prey of California sea lions, Zalophus californianus, at San Miguel Island, California 1978-1979. *Fish. Bull.* 82(1):67-76.
- Aurioles, D., C. Fox, F. Sinsel, and G. Tanos. 1984. Prey of the California sea lion (Zalophus californianus) in the Bay of La Paz, Baja California Sur, Mexico. *J. Mamm.* 65(3):519-521.
- Bailey, K.M. and D.G. Ainley. 1982. The dynamics of California sea lion predation on Pacific whiting. *Fish. Res.*, 1:163-176.
- Beach, R.J., A.C. Geiger, S.J. Jeffries, and S.D. Treacy. 1981. Marine mammal-Fisheries interactions on the Columbia River and adjacent waters, 1981. Unpublished MS.
- _____. 1982. Marine mammal-fisheries interactions on the Columbia River and adjacent waters, 1982. Unpublished MS.
- Bonnot, P. 1928. Report on the seals and sea lions of California. *Calif. Fish Game*, *Fish Bull.* 14:1-61.
- _____. 1932. A note on the fishing of the California sea lion. *Calif. Fish and Game* 18(1):98-99.
- Briggs, K.T. and C.W. Davis. 1972. A study of predation by sea lions on salmon in Monterey Bay, Calif. *Fish and Game* 58(1):37-43.
- DeMaster, D.P. 1983. Annual consumption of northern elephant seals and California sea lions in the California current. California Cooperative Oceanic Fisheries Investigations (CalCOFI) 1983 Conference Abstracts.

- DeMaster, D.P., D.J. Miller, D. Goodman, R.L. DeLong, and B.S. Stewart. 1982. Assessment of California sea lion fishery interactions. Trans. N. Am. Wildlf. and Nat. Res. Conf., 47:253-264.
- Dyche, L.L. 1903. Notes on the food habits of California sea-lions. Trans. Kansas Acad. Sci. 18:179-182.
- Fiscus, C.H. and G.A. Baines. 1966. Food and feeding behavior of Steller and California sea lions. J. Mammal. 47(2):195-200.
- Fitch, J.E. 1966. Additional fish remains, mostly otoliths, from a pleistocene deposit at Playa Del Rey, California. Los Angeles Co. Mus., Cont. in Sci., 119:1-16.
- _____. 1967. The marine fish fauna, based primarily on otoliths, of a lower pleistocene deposit at San Pedro, California (LACMIP 332, San Pedro Sand). Los Angeles Co. Mus., Cont. in Sci., 128: 1-23.
- _____. 1968. Otoliths and other fish remains from the Timms Point silt (early pleistocene) at San Pedro, California. Los Angeles Co. Mus., Cont. in Sci., 146:1-29.
- _____. 1969. Fossil record of certain schooling fishes of the California current system. Calif. Coop. Oceanic Fish. Invest. Rep., 13:71-80.
- _____. 1979. The velvet Whalefish, Barbourisia rufa, added to California's marine fauna, with notes on otoliths of whalefishes and possible related genera. Bull. Southern California Acad. Sci., 78(1):61-67.
- _____. 1972. Fish remains, primarily otoliths, from a coastal Indian midden (SLO-2) at Diablo Cove, San Luis Obispo County, California. San Luis Obispo Co. Archaeological Soc. Occasional Paper 7:101-120.
- Fitch, J.E. and L.W. Barker. 1972. The fish family Moridae in the eastern north Pacific with notes on morid otoliths, caudal skeletons, and the fossil record. Fish. Bull. 70(3):565-584.
- Fitch, J.E. and R.L. Brownell. 1968. Fish otoliths in cetacean stomachs and their importance in interpreting feeding habits. J. Fish. Res. Bd. Canada, 25(12):2561-2574.
- Fitch, J. E. and W.L. Craig. 1964. First records for the bigeye thresher (Alopias superciliosus) and slender tuna (Allothunnus fallai) from California, with notes on eastern Pacific scombrid otoliths. Calif. Fish and Game, 50(3):195-206.

- Frost, K.J. 1981. Descriptive key to the otoliths of gadid fishes of the Bering, Chukchi, and Beaufort Seas. *Arctic* 34(1):55-59.
- Huber, H.R., D.G. Ainley, S.H. Morrell, R.R. LeValley, and C.S. Strong. 1979. Studies of marine mammals at the Farallon Islands, California, 1977-1978. Final Rep. MMC Contract MM7AC025. NTIS pub. PB80-111602.
- Iverson, I.L.K., and L. Pinkas. 1971. A pictorial guide to beaks of certain eastern Pacific cephalopods. *Calif. Dept. Fish and Game, Fish Bull.* 152:83-105.
- Jameson, R.J. and K.W. Kenyon. 1977. Prey of sea lions in the Rogue River, Oregon. *J. Mammal.* 58(4):672.
- Jones, R.E. 1981. Food habits of smaller marine mammals from northern California. *Proc. Calif. Acad. Sci.* 42(16):409-433.
- Morejohn, G.V., J.T. Harvey, and L.T. Krasnow. 1978. The importance of Loligo opalescens in the food web of marine vertebrates in Monterey Bay, California. *Calif. Dept. Fish Game, Fish Bull.* 169:67-98.
- Morrow, J.E. 1979. Preliminary keys to otoliths of some adult fishes of the Gulf of Alaska, Bering Sea, and Beaufort Sea. NOAA Tech. Rept. NMFS Circular 420, 32pp.
- Rutter, C., R.F. Snodgrass, and E.C. Starks. 1902. Report of the sea lion investigation, 1901. In: Smith, H.M. 1902. Report on inquiry respecting food fishes and the fishing grounds. Report of the Commissioner for the year ending June 30, 1902. U.S. Comm. Fish and Fisheries. Part XXVIII. U.S.G.P.O., 1904; pp. 116-119.
- Scheffer, V.B. and J.A. Neff. 1948. Food of California sea-lions. *J. Mammal.* 29(10):67-68.
- Seagars, D.J., D.P. DeMaster, and R.L. DeLong. 1985. A survey of historic rookery sites for California and northern sea lions in the Southern California Bight. NOAA Admin. Rept. LJ-85-13.

Table 1. List of known *Zalophus californianus* prey compiled from the literature and from the present study.

PREY SCIENTIFIC NAME	COMMON NAME	REFERENCE(S) (a)	METHOD OF STUDY (b)	GEOGRAPHICAL AREA WHERE SEA LIONS FEED ON THAT PREY
AGONIDAE				
<i>Xeneretmus</i> sp.	poacher sp.	17	1	San Clemente Island, California
<i>Xeneretmus ritteri</i>	stripefin poacher	17	1	San Clemente Island, California
AMMODYTIDAE				
<i>Ammodytes hexapterus</i>	Pacific sand lance	9	3	Columbia River
ANOLOPOWATIDAE				
<i>Anoplopoma fimbria</i>	sablefish	5	1	San Miguel Island, California
ATHERINIDAE				
<i>Atherinopsis californiensis</i>	jacksmelt	1,3	2	South Farallon Islands, California
<i>Atherinops affinis</i>	topsmelt	17	1	San Clemente Island, California
---	silverside sp.	17	1	San Clemente Island, California
AULOPODIDAE				
<i>Aulopus</i> sp.	---	6	1	Los Islotes Island, Gulf of California, Mexico
BATHYLACIDAE				
<i>Bathylagus stilbius</i>	California smoothtongue	5	1	San Miguel Island, California
BATRACHOIDIDAE				
<i>Porichthys notatus</i>	plainfin midshipman	1,3,5,15,18	1,2,3	South Farallon Islands, California Monterey Bay, California; North-coastal California (c); San Miguel Island, California
BOTHIDAE				
<i>Citharichthys sordidus</i>	Pacific sanddab	3,9,17	1,2,3	South Farallon Islands, California Columbia River San Clemente Island, California
CRANGIDAE				
<i>Trachurus symmetricus</i>	jack mackerel	1,3,5,16,17	1,2,3	South Farallon Islands, California; North-coastal California (c); San Clemente Island, California; San Miguel Island, California
CENTROLOPHIDAE				
<i>Ichthyos lockingtoni</i>	medusafish	5	1	San Miguel Island, California
CLUPEIDAE				
<i>Clupea pallasii</i>	Pacific herring	1,3,9,16,19	2,3	South Farallon Islands, California La Jolla, California to Columbia River
<i>Alosa sapidissima</i>	American shad	8,9	3	Columbia River

Table 1. (Continued)

SCIENTIFIC NAME	PREY COMMON NAME	REFERENCE (S) (a)	METHOD OF STUDY (b)	GEOGRAPHICAL AREA WHERE SEA LIONS FEED ON THAT PREY
COTTIDAE				
<i>Leptocottus armatus</i>	staghorn sculpin	3,9	1,2,3	South Farallon Islands, California;
---	sculpin sp.	17	1	Columbia River San Clemente Island, California
EMBIOTOCIDAE				
<i>Amphistichus</i>	redtail surfperch	9	3	Columbia River
<i>Rhodoterus</i>	shiner surfperch	9	1,3	Columbia River
<i>Oymatogaster</i> aggregata	white seaperch	9	3	Columbia River
<i>Phanerodon furcatus</i>	pink surfperch	3,4,5	1,2	South Farallon Islands, California;
<i>Zalembius rosaceus</i>	surfperch sp.	9,16,17	1,3	San Miguel Island, California Columbia River; San Clemente Island, California; North-coastal California (c)
---	northern anchovy	1,3,4,5,9, 13,16,17,18	1,2,3	San Clemente Island to Columbia River
ENGRaulIDAE				
<i>Engraulis mordax</i>	flying fish	10	4	Cedros Island, Baja California, Mexico
EXOCOTIDAE				
---	Pacific tomcod	3,8,9,16	2,3	South Farallon Islands, California; North-coastal California (c);
GADIDAE				
<i>Microgadus proximus</i>	walleye pollack	9	3	Columbia River Columbia River
<i>Theragra</i> <i>Chalcogramma</i>	---	6	1	Los Islotes, Gulf of California, Mexico
HAEMULIDAE				
<i>Haemulopsis</i> sp.	lingcod	16	3	North-coastal California (c)
HEXAGRAMMIDAE				
<i>Ophiodon elongatus</i>	senorita	17	1	San Clemente Island, California
LABRIDAE				
<i>Oxyjulis californica</i>	sheephead	17	1	San Clemente Island, California
<i>Semicossyphus pulcher</i>	wrasse sp.	17	1	San Clemente Island, California
---	blacktail snailfish	17	1	San Clemente Island, California
LIPARIDIDAE				
<i>Careproctus melanurus</i>	blacktail snailfish	17	1	San Clemente Island, California

Table 1. (Continued)

PREY SCIENTIFIC NAME	COMMON NAME	REFERENCE(S) (a)	METHOD OF STUDY (b)	GEOGRAPHICAL AREA WHERE SEA LIONS FEED ON THAT PREY
MERLUCCIIDAE				
<i>Merluccius productus</i>	Pacific whiting (hake)	1,2,3,4,5, 8,9,13,14, 16,17,18	1,2,3	San Clemente Island to Columbia River
MYCTOPHIDAE				
<i>Stenobrachius leucopsarus</i>	Northern lampfish	5,17	1	San Miguel Island, California
<i>Symblophorus californiensis</i>	California lanternfish	4,5	1	San Clemente Island, California
---	lanternfish sp.	17	1	San Miguel Island, California
OPHIIDAE				
<i>Chilara taylori</i>	spotted cusk-eel	1,3,16,19	1,2,3	San Clemente Island, California; South Farallon Islands, California; North-coastal California (c)
<i>Lepophidium</i> sp.	---	6	1	Los Islotes Island, Gulf of California, Mexico
<i>Neobythites</i> sp.	---	6	1	Los Islotes Island, Gulf of California, Mexico
OSMERIDAE				
<i>Allosmerus elongatus</i>	whitebait smelt	9	1,3	Columbia River
<i>Hypomesus pretiosus</i>	surf smelt	9	3	Columbia River
<i>Thaleichthys pacificus</i>	eulachon	8,9	1,3	Columbia River
---	smelts sp.	16	3	North-coastal California (c)
PETROMYZONTIDAE				
<i>Entosphenus tridentatus</i>	lamprey	9,15	3	Rogue River; Columbia River
<i>Lampetra tridentata</i>	Pacific lamprey	9	1,3	Columbia River
PLEURONECTIDAE				
<i>Atheresthes stomias</i>	arrowtooth flounder	9	3	Los Islotes Island, Gulf of California, Mexico
<i>Glyptocephalus zachirus</i>	rex sole	1,3,17	1,2	South Farallon Islands, California
<i>Lyopsetta exilis</i>	slender sole	1,3,17	1,2	South Farallon Islands, California
<i>Microstomus pacificus</i>	clower sole	3,5,17	1,2	South Farallon Islands, California; San Miguel Island, California
<i>Parophrys vetulus</i>	english sole	1,3	2	San Clemente Island, California
<i>Psettichys melanostictus</i>	sand sole	9	1,3	San Miguel Island, California
---	"flatfish"	16	3	South Farallon Islands, California
POVALENTIDAE				
<i>Chromis punctipinnis</i>	blacksmith	17	1	North-coastal California (c)
				San Clemente Island, California

Table 1. (Continued)

SCIENTIFIC NAME	PREY	COMMON NAME	REFERENCE(S) (a)	METHOD OF STUDY (b)	GEOGRAPHICAL AREA WHERE SEA LIONS FEED ON THAT PREY
SALMONIDAE					
<i>Oncorhynchus</i> spp.	salmon sp.		11	4	Monterey Bay, California
<i>O. tshawytscha</i>	chinook salmon		16	3	North-coastal California (c)
<i>Salmo gairdnerii</i>	steelhead trout		9	1,3	Columbia River
SCIAENIDAE					
<i>Geryonemus lineatus</i>	white croaker		1,3,18	2,3	South Farallon Islands, California; Monterey Bay, California
<i>Seriophus politus</i>	queenfish		4,5,16	1,3	San Miguel Island, California; North-coastal California (c)
SCOMBRIDAE					
<i>Scomber japonicus</i>	chub mackerel		5,17	1	San Miguel Island, California; San Clemente Island, California
SCORPAENIDAE					
<i>Sebastes goodei</i>	chilipepper		14	2	South Farallon Islands, California
<i>Sebastes</i> spp.	"rockfish"		1,3,4,5,7,17	1,2,3	San Clemente Island to Columbia River
<i>Pontinus</i> sp.	---		6	1	Los Islotes, Gulf of California, Mexico
SERRANIDAE					
<i>Pronotogrammus</i> sp.	---		6	1	Los Islotes, Gulf of California, Mexico
<i>Hemanthias</i> sp.	---		6	1	Los Islotes, Gulf of California, Mexico
<i>Serranus</i> sp.	---		6	1	Los Islotes, Gulf of California, Mexico
<i>Anthias</i> sp.	---		6	1	Los Islotes, Gulf of California, Mexico
<i>Diplectrum</i> sp.	---		6	1	Los Islotes, Gulf of California, Mexico
SQUALIDAE					
<i>Squalis acanthias</i>	spiny dogfish		18	2,3	Monterey Bay, California
STROMATEIDAE					
<i>Peprilus simillimus</i>	Pacific pompano		4,5	1	San Miguel Island, California
ZOARCIDAE					
<i>Lycodes corteziensis</i>	bigfin eelpout		17	1	San Clemente Island, California

Table 1. (Continued)

PREY SCIENTIFIC NAME	COMMON NAME	REFERENCE(S) (a)	METHOD OF STUDY (b)	GEOGRAPHICAL AREA WHERE SEA LIONS FEED ON THAT PREY
CEPHALOPODA:				
"Unspecified Squid"				
	"squid"	1,12,13,19	2,3	La Jolla, California; Monterey Bay, California; South Farallon Islands, California
GONATIDAE				
<i>Beriteuthis</i> sp.	squid	3	2	South Farallon Islands, California
<i>Gonatus</i> sp.	squid	1,3,4,5,	1,2,3	South Farallon Islands; Monterey Bay, California; San Miguel Island, California
—	gonatid squid	5,17	1	San Clemente Island, California; San Miguel Island, California
EROLIOTEUTHIDAE				
<i>Abraliopsis</i> spp.	squid	17	1	San Clemente Island, California
HISTIOTEUTHIDAE				
<i>Histioteuthis</i> sp.	squid	4	1	San Miguel Island, California
LOLIGINIDAE				
<i>Loligo opalescens</i>	market squid	2,3,4,5,9,13,17,18	1,2,3	San Clemente Island, California to Columbia River
MISTICOTEUTHIDAE				
<i>Mastigoteuthis</i> sp.	squid	17	1	San Clemente Island, California
ONYCHOTEUTHIDAE				
<i>Onychoteuthis borealijaponicus</i>	squid	4,5,17,18	1,2,3	San Clemente Island, California; San Miguel Island, California; Monterey Bay, California
OCTODIDAE				
<i>Octopoda</i>	octopus	4,12,18	1,2,3	San Miguel Island, California; Monterey Bay, California
<i>Octopus bimaculatus</i>	two-spotted octopus	5	1	San Miguel Island, California
<i>O. rubescens</i>	red-octopus	3,5	1,2	South Farallon Islands, California; San Miguel Island, California
<i>Octopus</i> sp.	octopus	17	1	San Clemente Island, California
OCTOPOTEUTHIDAE				
<i>Octopodoteuthis deletron</i>	squid	17	1	San Clemente Island, California
CRUSTACEAN:				
GALATHEIDAE				
<i>Pleuroncodes planipes</i>	pelagic red crab	17	1	San Clemente Island
CRANGIDAE				
<i>Crangon</i> sp.	crangon shrimp	9	1	Columbia River

Table 1. (Continued)

a. References:

1. Ainley, D.G., H.R. Huber, R.P. Henderson, T.J. Lewis, and S.H. Morrell, 1977.
2. Ainley, D.G., H.R. Huber, S.H. Morrell, and R.R. LeValley, 1978.
3. Ainley, D.G., H.R. Huber, and K.M. Bailey, 1982.
4. Antonellis, G.A. and C.H. Fiscus, 1980.
5. Antonellis, G.A., C.H. Fiscus, and R.L. DeLong, 1984.
6. Auriolles, D., C. Fox, and F. Sinsel, 1981.
7. Bailey, K.M. and D.G. Ainley, 1982.
8. Beach, R.J., A.C. Geiger, S.J. Jeffries, and S.D. Treacy, 1981.
9. _____, 1982.
10. Bonnot, P., 1932.
11. Briggs, K.T. and C.W. Davis, 1972.
12. Dyche, L.L., 1903.
13. Fiscus, C.H. and G.A. Baines, 1966.
14. Huber, H.R., D.G. Ainley, S.H. Morrell, R.R. LeValley, and C.S. Strong, 1979.
15. Jameson, R.J. and K.W. Keryon, 1977.
16. Jones, R.E., 1981.
17. Lowry, M.S. and C.W. Oliver, (study reported here).
18. Morejohn, G.V., J.T. Harvey, and L.T. Krasnow, 1978.
19. Scheffer, V.B. and J.A. Neff, 1948.

b. METHOD OF STUDY CODES: 1=Scats; 2=Spewings; 3=Stomach/Gastrointestinal Contents; 4=Direct Observations

c. North-coastal California was used by Jones (1981) to include specimens which were collected from the California counties of Monterey, San Mateo, Marin, Sonoma, and Humboldt.

Table 2. Collection periods, dates of collection, and numbers and type of Zalophus californianus scat samples obtained from San Clemente Island, California from September 1981 through March 1983.

COLLECTION PERIOD	DATE OF COLLECTION	NUMBER OF SCATS COLLECTED ONE COLLECTION PERIOD		NUMBER OF SCATS COLLECTED PERIOD OLD		NUMBER OF SCATS COLLECTED PERIOD OLD		TOTAL NUMBER OF ALL SCATS COLLECTED
		FRESH	DRY	DRY	TOTAL	GREATER THAN ONE COLLECTION PERIOD OLD	COLLECTION PERIOD OLD	
1	1981 Sep. 9-10	4	3	7	7	0	0	7
2	1981 Oct. 14-15	11	7	18	18	7	7	25
3	1981 Nov. 15	7	9	16	16	0	0	16
4*	1982 Jan. 28	0	3	3	3	0	0	3
5	1982 Mar. 24	1	31	32	32	13	13	45
6	1982 Apr. 27-29	14	33	47	47	21	21	68
7+	1982 May 13	0	4	4	4	0	0	4
8+	1982 May 26-27	12	12	24	24	19	19	43
9	1982 June 30	25	33	58	58	0	0	58
10	1982 July 14	15	1	16	16	0	0	16
11	1982 July 28-29	21	29	50	50	7	7	57
12	1982 Aug. 21	15	4	19	19	0	0	19
13	1982 Nov. 2-5	1	53	54	54	0	0	54
14	1982 Dec. 28-29	0	16	16	16	0	0	16
15	1983 Feb. 26	3	40	43	43	0	0	43
16	1983 Mar. 20	11	13	24	24	0	0	24

* Not used in temporal analysis

+ Combined in temporal analysis

Table 3. Occurrence of prey, composition of prey, and minimum number of prey determined for positive-identified prey found in 424 California sea lion (*Zalophus californianus*) scats collected at San Clemente Island, California, from September 1981 through March 1983. (Data impossible to compute in fields marked with a dash [-]; N OCC = number of occurrences; PO = percent occurrence; PPC = percent prey composition; and PMN = percent minimum number).

SCIENTIFIC NAME	COMMON NAME	OCCURRENCE			PREY COMPOSITION			MINIMUM NUMBER	
		N	SCATS	PO	N	OCC	PPC	N	PMN
<i>Trachurus symmetricus</i>	jack mackerel	294	46	194	21	792	19		
<i>Engraulis mordax</i>	northern anchovy	167	39	167	18	1591	39		
<i>Loligo opalescens</i>	market squid	104	25	104	11	922	22		
<i>Sebastes</i> spp.	rockfish	72	17	72	8	217	5		
<i>Merluccius productus</i>	Pacific whiting	71	17	71	8	194	5		
<i>Scomber japonicus</i>	Pacific mackerel	63	15	63	7	111	3		
<i>Chromis punctipinnis</i>	blacksmith	42	10	42	5	129	3		
<i>Pleuroncodes planipes</i>	pelagic red crab	15	4	15	2	-	-		
<i>Onychoteuthis boreali-japonicus</i>	squid	11	3	11	1	13	<1		
<i>Oxyjulis californica</i>	senorita	5	1	5	1	5	<1		
<i>Lyopsetta exilis</i>	slender sole	5	1	5	1	13	<1		
<i>Gonatus</i> sp.	squid	4	1	4	<1	4	<1		
EPHIOTIDAE	unidentified surfperch	3	1	3	<1	8	<1		
<i>Octopus</i> sp.	octopus	3	1	3	<1	3	<1		
ATHERINIDAE	unidentified silverside	3	1	2	<1	3	<1		
LABRIDAE	unidentified wrasse	3	1	3	<1	8	<1		
MYCTOPHIDAE	unidentified lanternfish	3	1	3	<1	1	<1		
COTTIDAE	unidentified sculpins	2	<1	2	<1	4	<1		
<i>Abraliopsis</i> spp.	squid	2	<1	2	<1	2	<1		
<i>Atherinops affinis</i>	topsmelt	1	<1	1	<1	1	<1		
<i>Chilara taylori</i>	spotted cusk eel	1	<1	1	<1	1	<1		
<i>Semicossyphus pulcher</i>	sheephead	1	<1	1	<1	1	<1		
<i>Careproctus melanurus</i>	blacktail snailfish	1	<1	1	<1	1	<1		
<i>Citharichthys sordidus</i>	Pacific sanddab	1	<1	1	<1	1	<1		
<i>Glyptocephalus zachirus</i>	rex sole	1	<1	1	<1	1	<1		
<i>Microstomus pacificus</i>	dover sole	1	<1	1	<1	1	<1		
<i>Lycodes corteziensis</i>	bigfin eelpout	1	<1	1	<1	1	<1		
<i>Xeneretmus</i> sp.	poacher species	1	<1	1	<1	1	<1		
<i>Xeneretmus ritteri</i>	stripfin poacher	1	<1	1	<1	1	<1		
<i>Stenobrachius leucopsarus</i>	northern lampfish	1	<1	1	<1	1	<1		
<i>Mastigoteuthis</i> spp.	squid	1	<1	1	<1	2	<1		
GONATIDAE	unidentified gonatid squid	1	<1	1	<1	1	<1		
<i>Octopodoteuthis deletron</i>	squid	1	<1	1	<1	1	<1		

Table 4. Occurrence of prey, composition of prey, and minimum number of prey determined for all questionable prey identifications and unidentified prey found in 424 California sea lion (*Zalophus californianus*) scats collected at San Clemente Island, California, from September 1981 through March 1983. (Data impossible to compute in fields marked with a dash [-]); N OCC = number of occurrences; PO = percent occurrence; PPC = percent prey composition; and PMN = percent minimum number).

PREY		OCCURRENCE		PREY COMPOSITION		MINIMUM NUMBER	
SCIENTIFIC NAME	COMMON NAME	N SCATS	PO	N OCC	PPC	N	PMN
QUESTIONABLE IDENTIFICATIONS							
<i>Engraulis mordax</i> ?	northern anchovy	25	6	25	3	7	<1
<i>Trachurus symmetricus</i> ?	jack mackerel	22	5	22	2	33	1
<i>Loligo opalescens</i> ?	market squid	14	3	14	2	24	1
<i>Sebastes</i> spp.?	rockfish	9	2	9	1	6	<1
<i>Merluccius productus</i> ?	pacific whiting	6	1	6	1	1	<1
<i>Onychoteuthis borealijaponicus</i> ?	squid	3	1	3	<1	3	<1
<i>Gonatus</i> sp.?	squid	2	<1	2	<1	2	<1
<i>Chromis punctipinnis</i> ?	blacksmith	2	<1	2	<1	1	<1
<i>Scomber japonicus</i> ?	Pacific mackerel	1	<1	1	<1	1	<1
<i>Glyptocephalus zachirus</i> ?	rex sole	1	<1	1	<1	1	<1
UNIDENTIFIED							
UNIDENTIFIED FISHES	"various fish species"	35	7	35	4	10	<1
UNID. CEPHALOPOD	squid/octopus	10	2	10	1	2	<1
UNID. FISH TOOTH	Unidentified fish	4	1	4	<1	-	-
UNID. CARTILAGINOUS FISH		1	<1	1	<1	-	-

Table 5. Percent occurrence and percent minimum number of prey for the seven common prey found in California sea lion (*Zalophus californianus*) scats collected at San Clemente Island, California for 16 collection periods during September 1981 through March 1983. Dates for collection period given in Table 2.

PREY	COLLECTION PERIODS															
	1	2	3	4	5	6	7+8	9	10	11	12	13	14	15	16	
jack mackerel (<i>Trachurus symmetricus</i>):																
Percent occurrence (PO)	80	56	47	100	36	32	76	63	13	43	72	65	67	15	22	
Percent minimum number (PMN)	30	19	26	57	19	11	28	34	2	11	70	35	26	2	4	
northern anchovy (<i>Engraulis mordax</i>):																
Percent occurrence (PO)	20	19	33	0	61	50	40	9	94	39	6	43	17	47	57	
Percent minimum number (PMN)	30	6	30	0	63	60	24	21	95	17	0	49	7	48	81	
market squid (<i>Loligo opalescens</i>):																
Percent occurrence (PO)	60	56	20	67	14	5	36	28	19	30	17	16	58	15	17	
Percent minimum number (PMN)	17	53	35	29	5	1	9	18	2	61	3	4	50	22	2	
Pacific whiting (<i>Merluccius productus</i>):																
Percent occurrence (PO)	20	38	0	33	7	26	44	14	0	25	6	6	0	3	0	
Percent minimum number (PMN)	11	13	0	3	1	7	13	3	0	3	1	1	0	<1	0	
rockfish (<i>Sebastes</i> spp.):																
Percent occurrence (PO)	20	6	7	33	14	13	36	9	6	11	28	10	25	29	30	
Percent minimum number (PMN)	2	0	1	2	2	4	11	5	0	1	9	1	3	24	4	
Pacific mackerel (<i>Scomber japonicus</i>):																
Percent occurrence (PO)	20	25	0	67	14	24	24	9	0	9	22	24	25	6	13	
Percent minimum number (PMN)	2	4	0	5	4	8	3	2	0	1	5	4	3	1	3	
blacksmith (<i>Chromis punctipinnis</i>):																
Percent occurrence (PO)	40	19	20	0	0	8	12	12	0	11	11	8	8	6	17	
Percent minimum number (PMN)	6	3	6	0	0	5	7	7	0	3	4	3	3	1	3	
Sample size (n = scats with prey)	5	16	15	3	28	38	25	43	16	44	18	51	12	34	23	

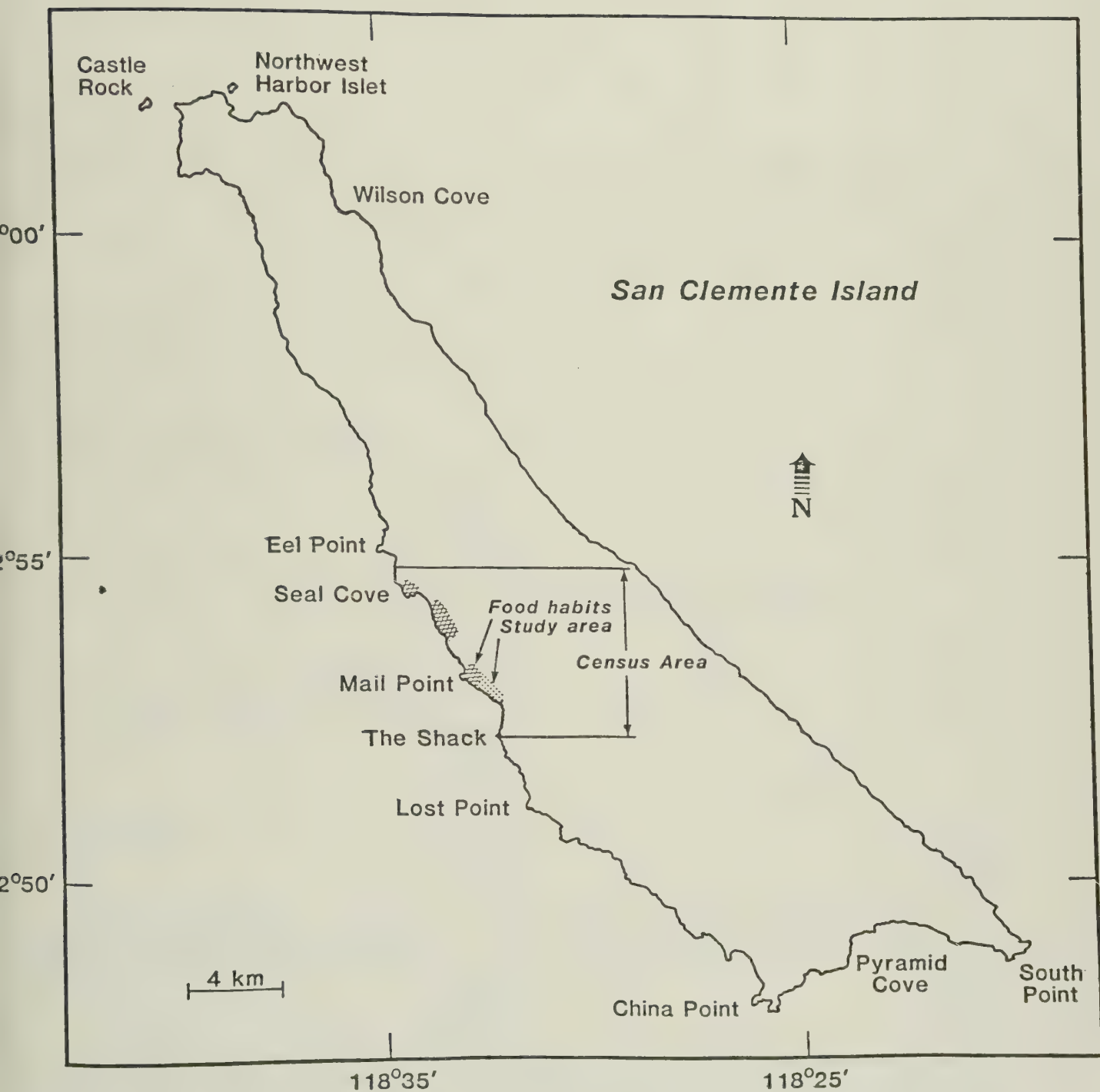


Figure 1. San Clemente Island (SCI) showing area where census and food habits were conducted on California sea lions, *Zalophus californianus*, during September 1981 through March, 1983. Areas where breeding was observed are indicated by crosshatch. Areas used primarily as haulouts are indicated with stiple.

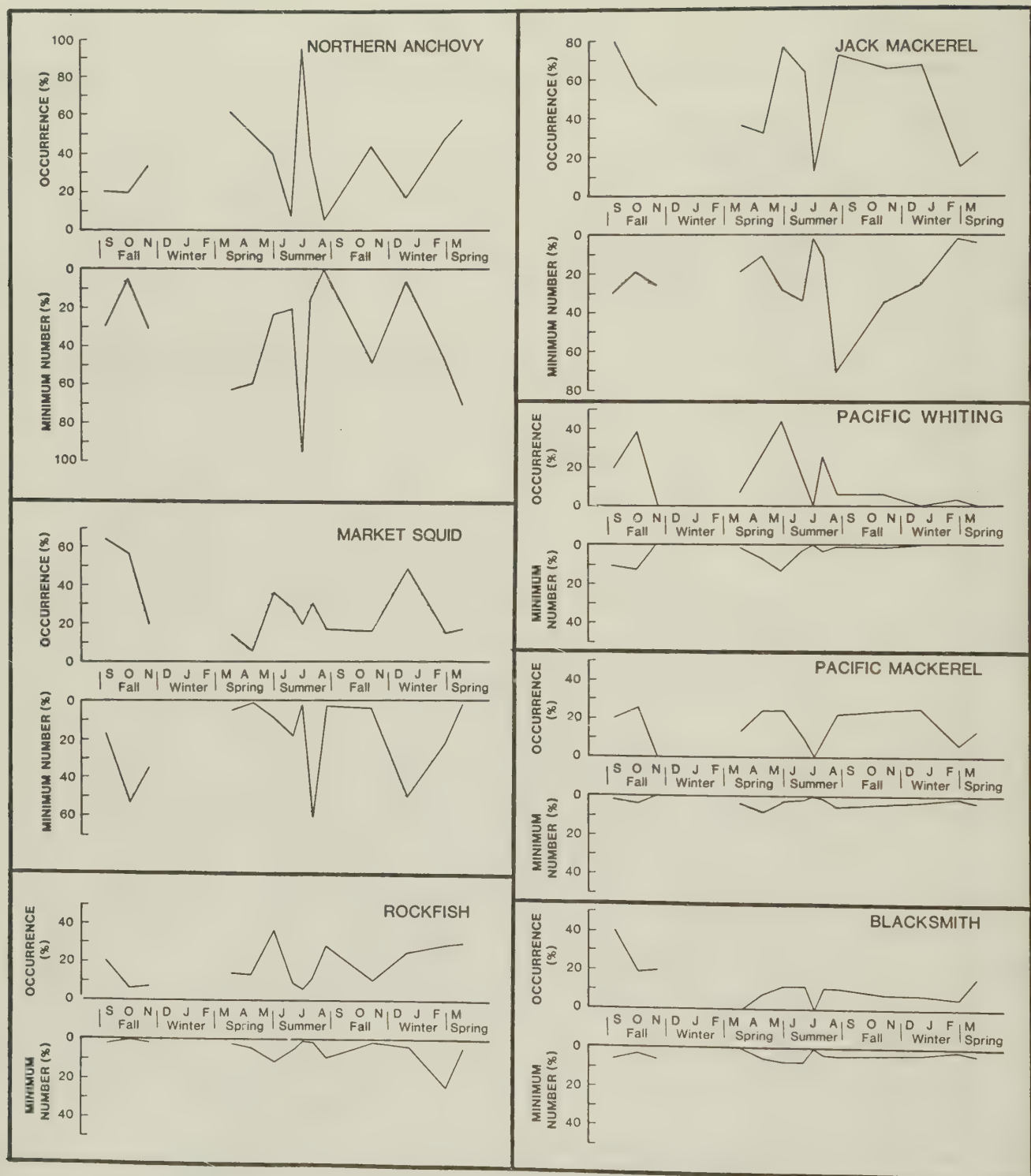


Figure 2. Percent occurrence and percent minimum number of the seven common prey found in California sea lion (*Zalophus californianus*) scats collected at San Clemente Island, California, from September 1981 through March 1983.

